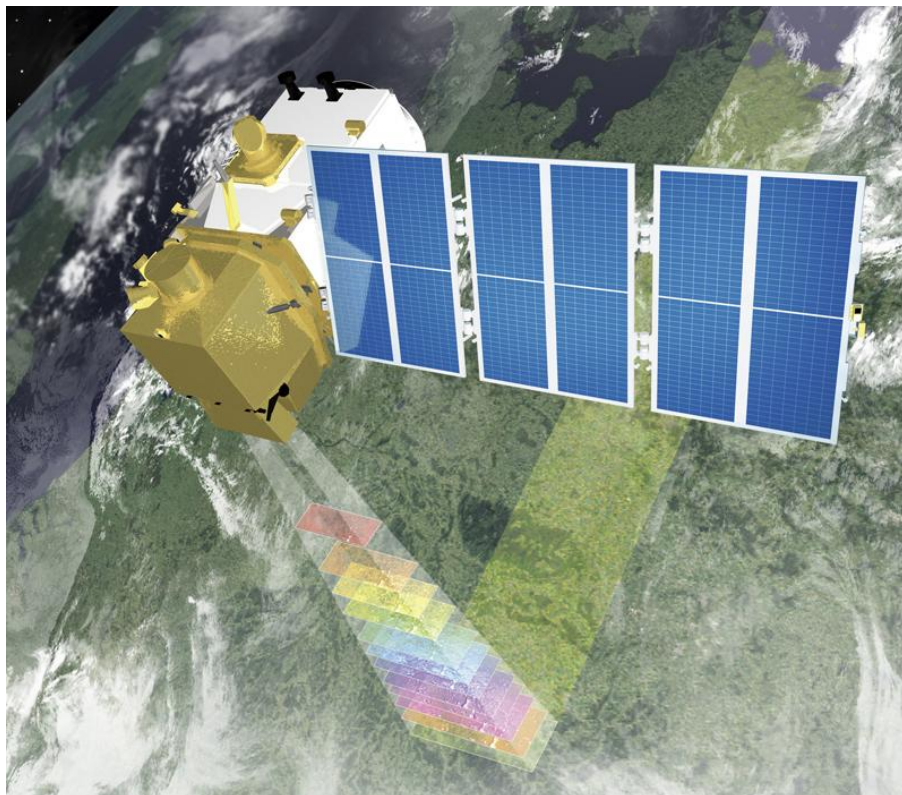


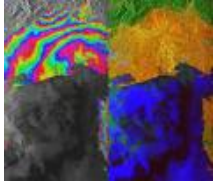
Sentinel-2

Optical High Resolution Mission for GMES Operational Services



*Philippe Martimort,
Sentinel-2 Mission and Payload Manager
European Space Agency (ESA)*

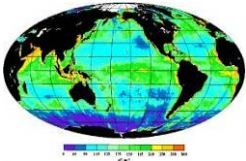
- The GMES programme will provide data & integrated services for environmental monitoring and security.
- The European Commission (EC) and the European Space Agency (ESA) co-fund the development phase of the programme.
- The Space Component is implemented by the European Space Agency (ESA).
- GMES Space Component aims at delivering data through:
 - Contributing missions.
 - GMES dedicated satellites (“the Sentinels”).



Sentinel-1 – SAR imaging



Sentinel-2 – High resolution optical imaging



Sentinel-3 – Low resolution optical imaging + Altimetry



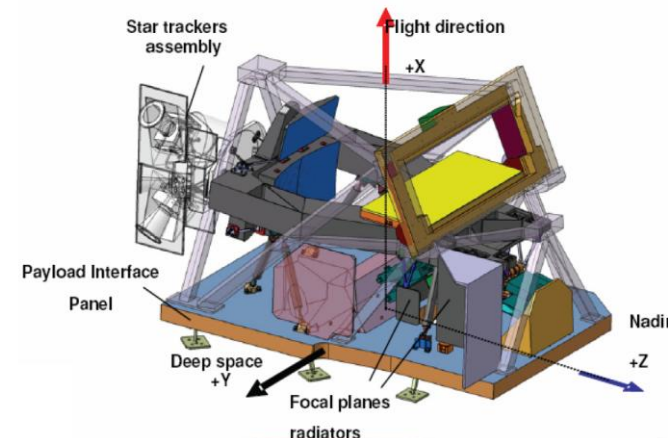
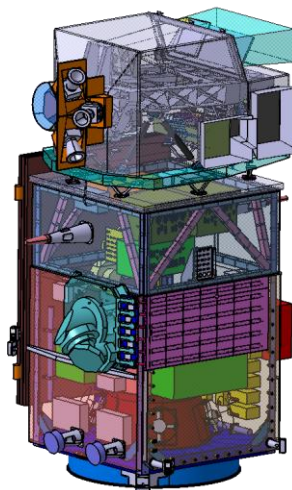
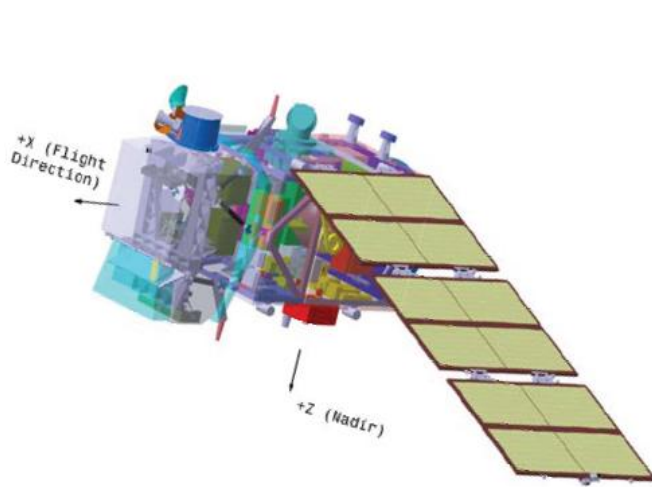
Sentinel-4 – Atmospheric Monitoring from GEO

Sentinel-5 – Atmospheric Monitoring from LEO



General services: Global carbon, Crop monitoring, Spatial planning (vegetation, urban), Forest monitoring, Water services, Soil erosion, large scale natural or man made disasters, surveillance of infrastructures

Thematic services: Sustainable management of developing countries, Nature protection services, support to humanitarian aid, Food security



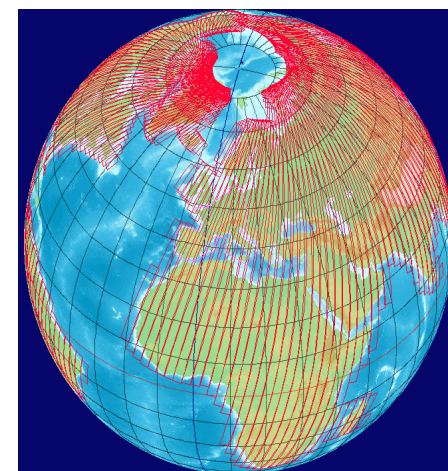
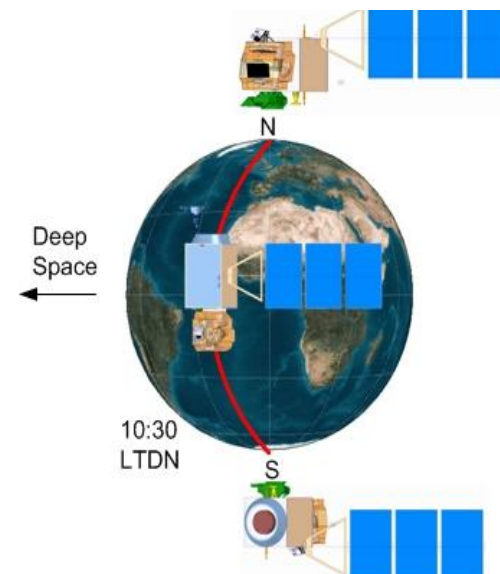
Satellite

- Satellite mass: 1200 kg
- Satellite power consumption: 1250 W
- Hydrazine propulsion system (120 kg - including provision for safe mode, debris avoidance and EOL orbit decrease for faster re-entry)
- Accurate AOCS based on multi-head Star Tracker and fiber optic gyro
- TT&C using S band (64 Kb/s up – 2 Mb/s down), with authenticated/encrypted commands
- X band mission data distribution (520 Mbits/sec)
- Mission data onboard storage: 2.4 Tbits
- Resources available to embark an optional Laser Communication Terminal

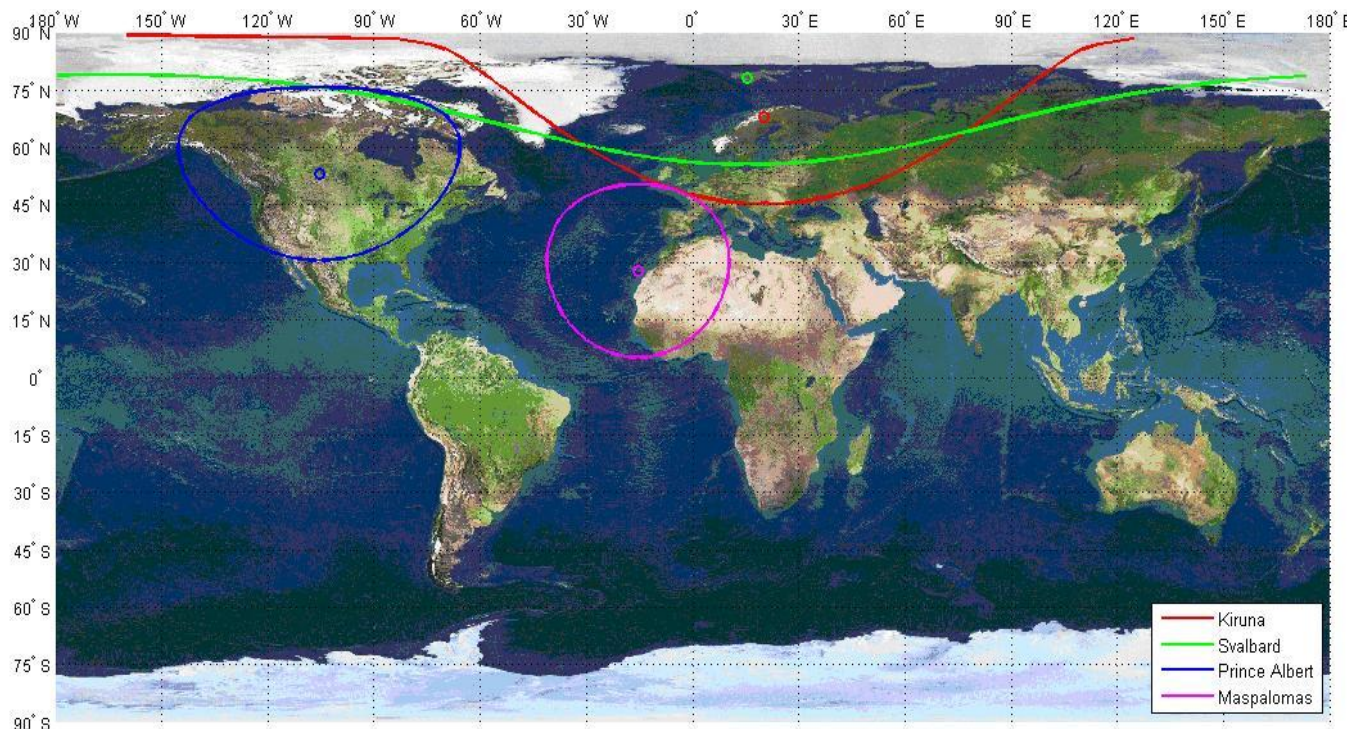
MultiSpectral instrument

- Filter based push broom imager (280 kg, 1 m³)
- Three mirrors silicon carbide telescope, with dichroic beam splitter
- Focal plane arrays: Si CMOS VNIR detectors, HgCdTe SWIR detectors passively cooled (190 K)
- Onboard wavelet compression (~1/3)
- Integrated video & compression electronics (state of the art wavelet compression)
- Radiometric resolution 12bits
- Radiometric accuracy < 5%

- **Spacecraft:** 2 operating in twin configuration
- **Spectra bands:** 13 (VIS–NIR–SWIR spectral domains)
- **Spatial resolution:** 10m / 20m / 60m
- **Orbit:** Sun-synchronous at 786 km (14+3/10 revs per day), with LTDN 10:30 AM
- **Swath width:** 290 km
- **Geographic coverage:** Systematic, all land & coastal surfaces between -56° & $+84^{\circ}$ Latitude
- **Revisit:** 5 days at equator (with 2 satellites - without considering clouds)
- **Emergency lateral pointing mode:** access any point on Earth within 1 to 2 days
- **Multispectral Instrument:** operating in pushbroom principle, filter based optical system, low noise image compression techniques
- **Lifetime:** 7.25 year extendable to 12 years

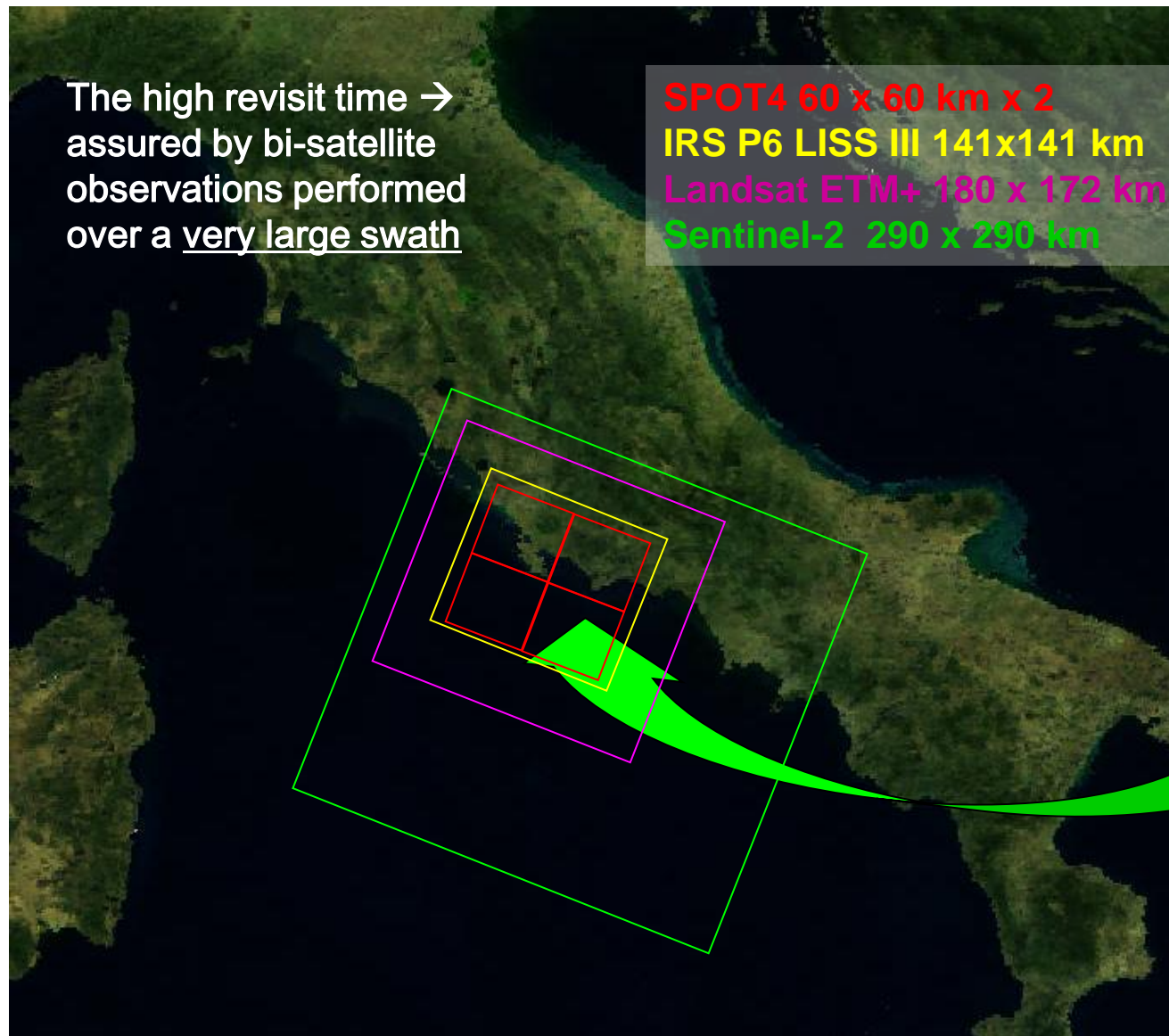
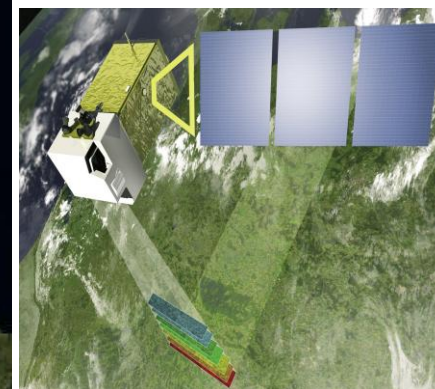


- Most data delivered to 4 core ground stations within 1-3 hours after acquisition.
- 800 GByte per day (~400 DVDs), cloud-free images will be further processed.
- X band data downlink with 520 Mbit/s transmission RF system (after onboard wavelet compression)
- Optional Laser Communication through GEO terminal (S2 already made compatible with the LCT terminal)



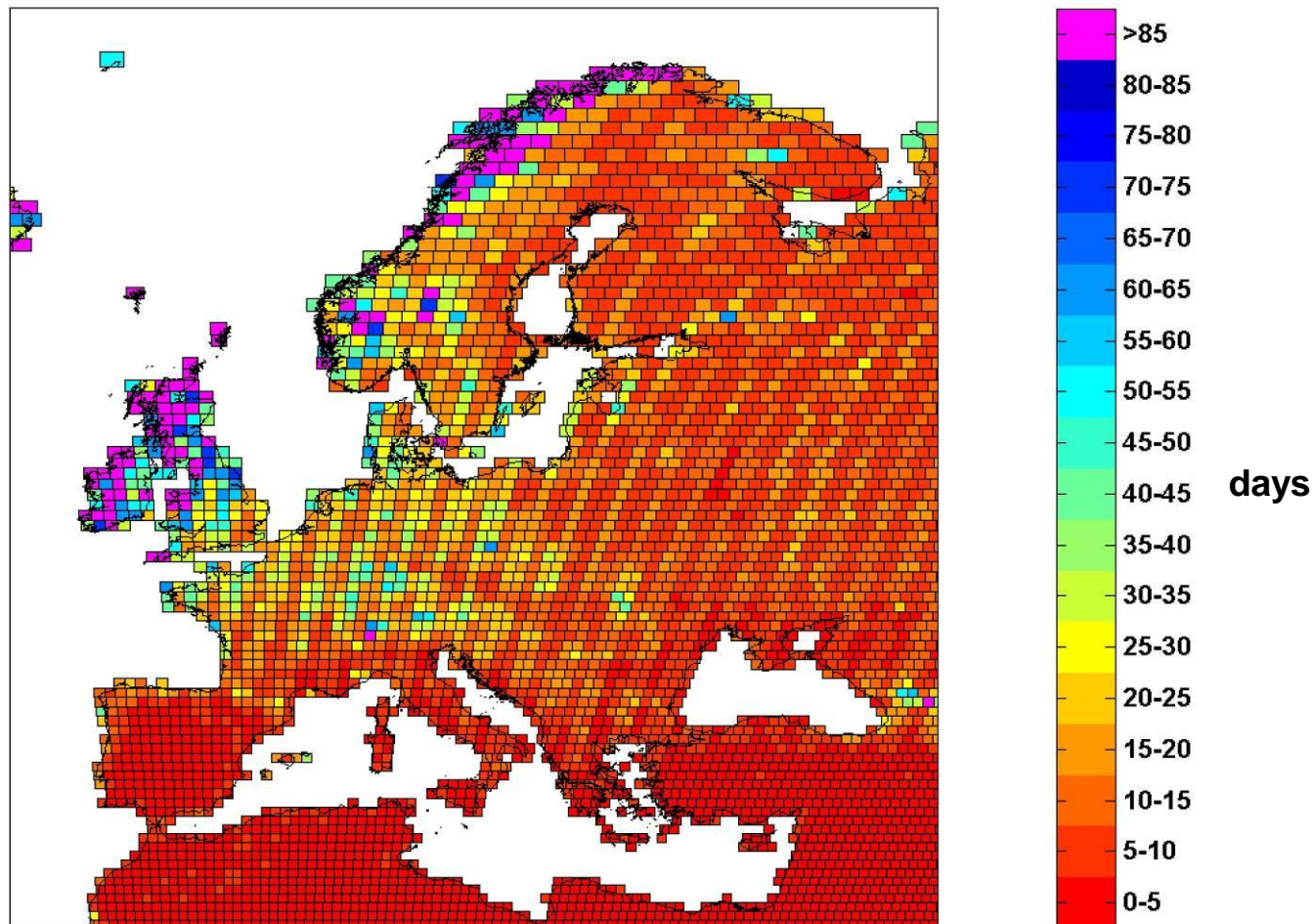
The high revisit time →
assured by bi-satellite
observations performed
over a very large swath

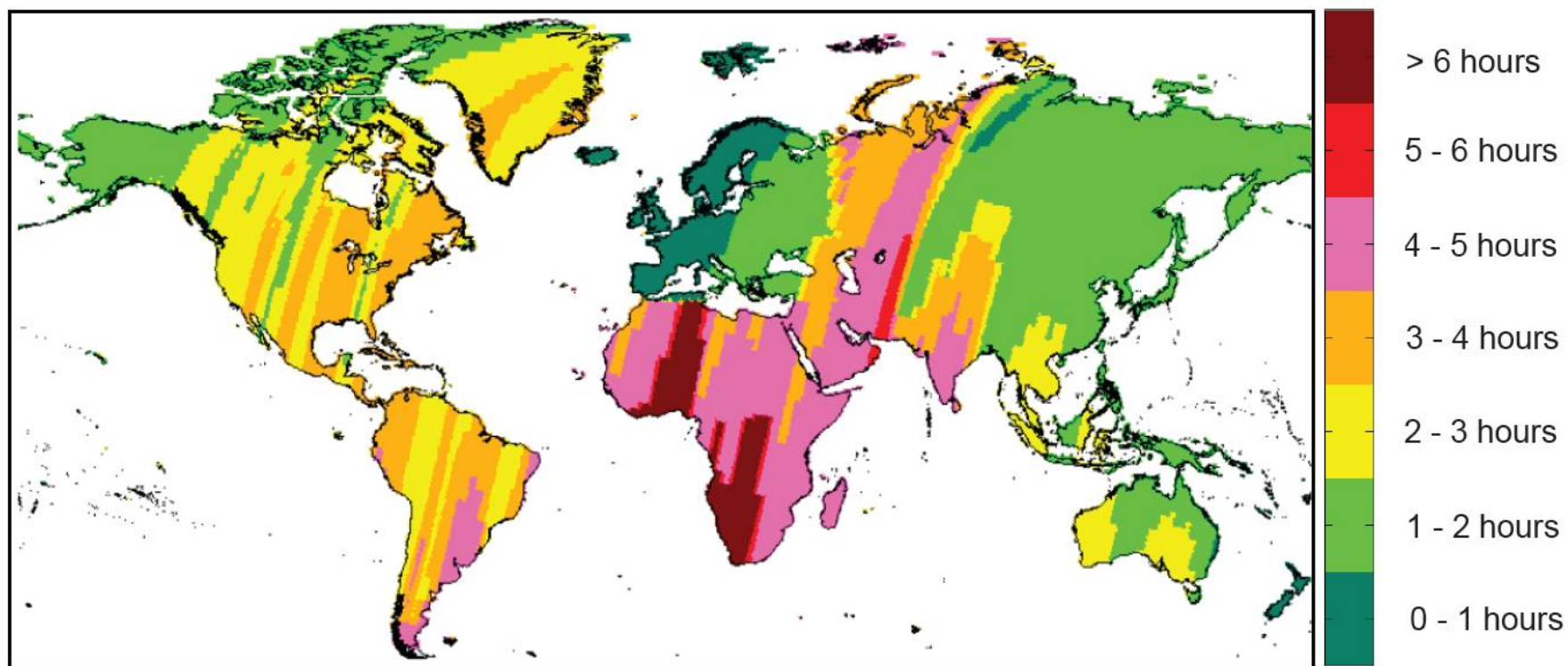
SPOT4 60 x 60 km x 2
IRS P6 LISS III 141x141 km
Landsat ETM+ 180 x 172 km
Sentinel-2 290 x 290 km



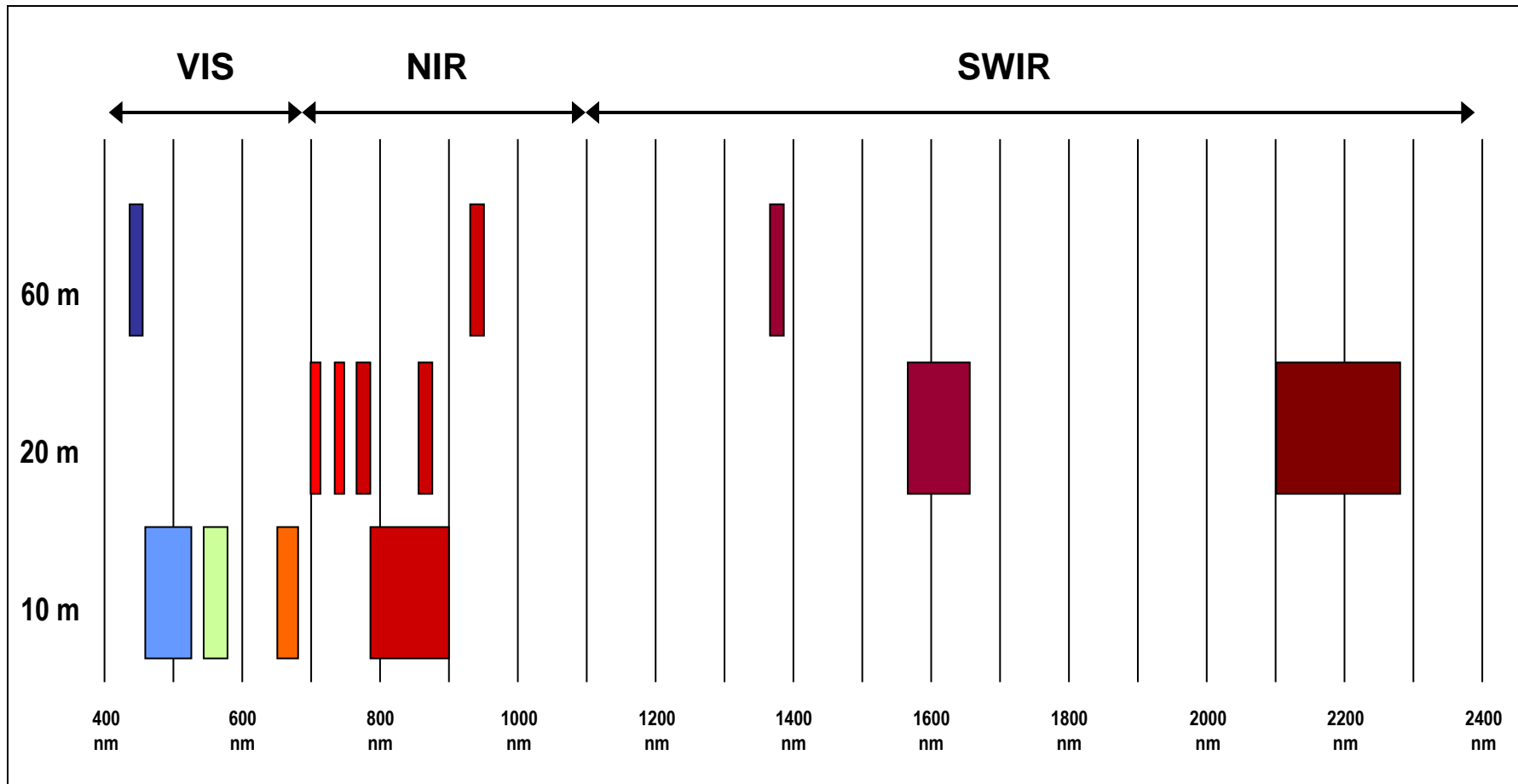
Revisit time over Europe in summer with 2 satellites (considering cloud cover)

Maximum effective coverage time for SC1 & SC2 (days) (<15% cloud cover; 68% confidence)



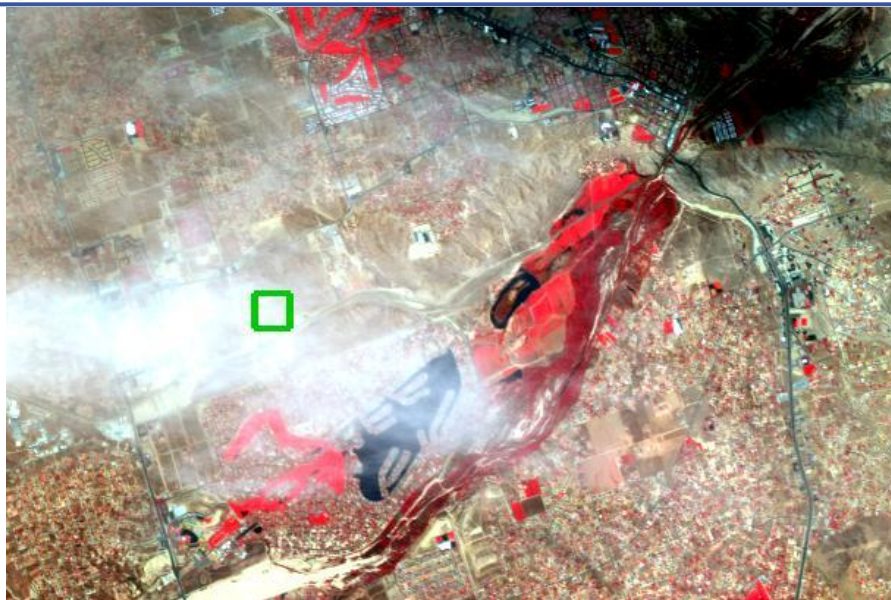


Latency can be controlled by priority / NRT assignment:

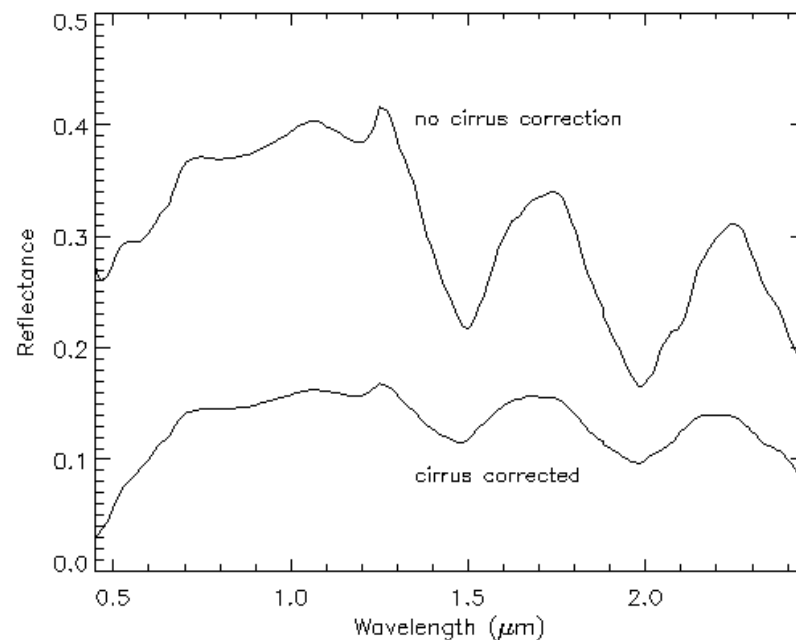


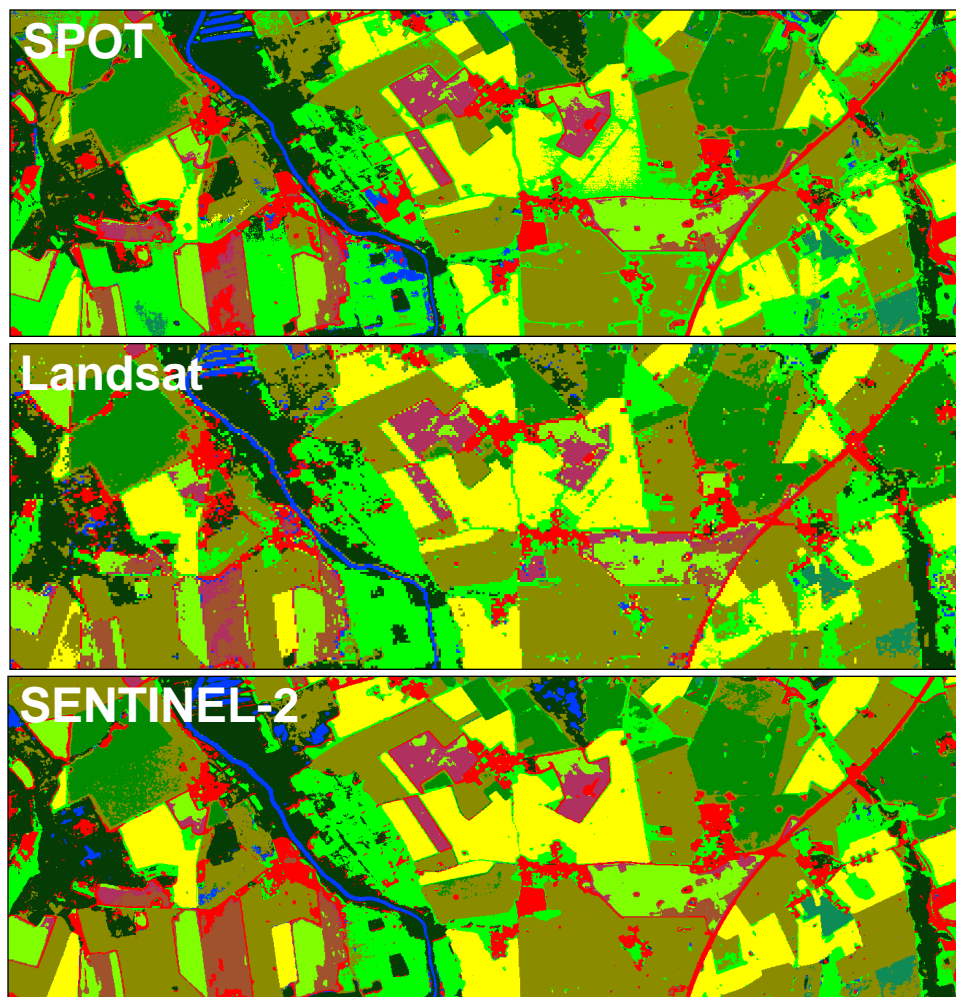
Spectral bands versus spatial resolution

- **Level 1** image processing includes:
 - (a) Radiometric Corrections (Straylight/crosstalk correction and defective pixels exclusion, De-noising, De-convolution, Relative and Absolute Calibration).
 - (b) Geometric Corrections (Co-registration inter-bands and inter-detectors, Ortho-rectification).
- **Level 2** image processing includes:
 - (a) Cloud Screening.
 - (b) Atmospheric Corrections (including thin cirrus, slope and adjacency effects correction).
 - (c) Geophysical variables retrieval algorithms (e.g. fAPAR, leaf chlorophyll content, leaf area index, land cover classification).
- **Level 3** provides spatio-temporal synthesis.



Simulation of cloud corrections within a Level 2 image





forest
water
urban
winter barley
sugar beets
potatoes
spring barley
winter wheat
grassland/pasture
maize
rape

Simulated SPOT-5: 4 bands [3-4-8-11]

88.5% overall accuracy

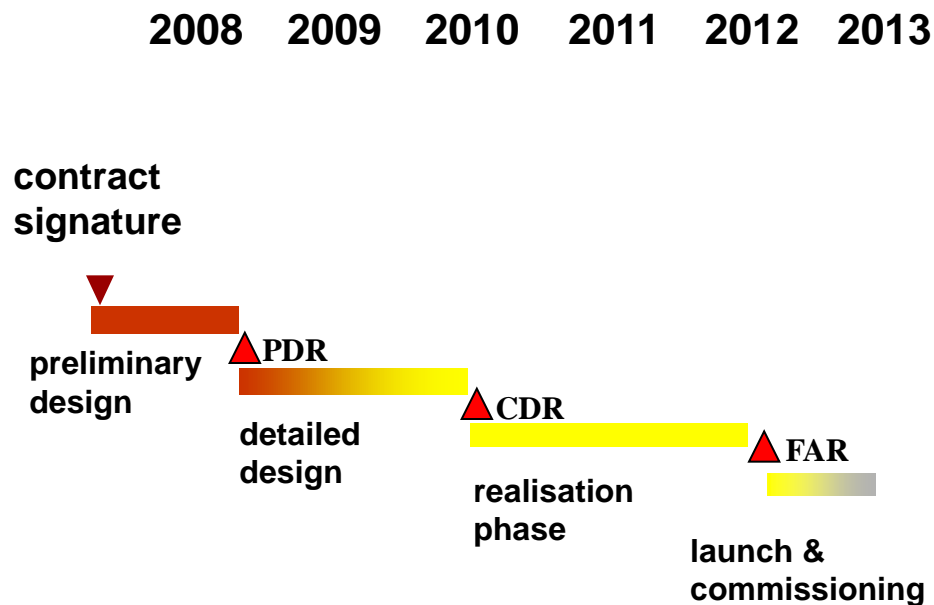
Simulated Landsat-5: 6 bands [2-3-4-8-11-12]

91.3% overall accuracy

Sentinel-2: 10 bands [2-3-4-5-6-7-8-8a-11-12]

95.4% overall accuracy

AgriSAR campaign – Courtesy: Mattia Marconcini



Launch with new European launcher
VEGA (Eurockot as backup)



GMES Sentinel-2 combines...

A very large swath (290 km)

A high revisit frequency (5 days periodicity @ equator)

Systematic acquisition of all land surfaces and coastal waters

High spatial resolution (given the swath - 10m / 20m / 60m)

Accurate geo-location (20m without Ground Control Points)

Accurate multi-temporal pixel co-registration (0.3 SSD)

Onboard calibration using a full FOV Sun diffuser

A large number of spectral bands (13 in VNIR-SWIR domain)

for more accurate cloud screening, atmospheric corrections and
geophysical variables retrieval

Thank You for Your Attention !

More information at <http://www.esa.int/gmes>